TULARE LAKE BED
COORDINATED
GROUNDWATER MANAGEMENT PLAN
(SB 1938 COMPLIANT)

Adopted
7/27/12

July 27, 2012

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I. INTRODUCTION

Participants in this Coordinated Groundwater Management Plan (the Plan) consist of water agencies and private landowners located within the Tulare Lake area. Due to the unique geology, topography, and water resources in the Tulare Lake area, the participants have elected to manage their groundwater resources under a single coordinated plan. Figure 1 is a location map of the Tulare Lake sub-basin and the Plan boundary. Plan participants are listed as follows and a brief summary about each participant is provided at the end of this chapter.

- Alpaugh Irrigation District
- Angiola Water District
- Atwell Island Water District
- City of Corcoran
- Corcoran Irrigation District
- Lovelace Reclamation District #739
- Melga Water District
- MOU Private Lands
- Salyer Water District
- Tulare Lake Basin Water Storage District
- Tulare Lake Reclamation District #761

Plan Authority

Agencies participate in the Plan in accordance with the terms of a Joint Powers Agreement (JPA) entered into pursuant to California Water Code Section 10755.2 which provides for adoption and implementation of coordinated groundwater management plans. The JPA allows for amendments to include additional local agencies, public and private entities, and private parties as participants in the Plan. Private landowners participate in accordance with the JPA and a Memorandum of Understanding (MOU). Tulare Lake Basin Water Storage District is the administrator of the Plan.

The Plan was first adopted and implemented in 1997 under California Water Code Sections 10750 et. seq., which includes codification of California Assembly Bill 3030. This document updates the original Plan to comply with requirements of California Senate Bill 1938, which amended the Water Code in 2002.

Purpose

The coordinated approach provides a framework for the local management of groundwater resources, allowing participants to collectively pursue Plan objectives versus each agency implementing its own groundwater management activities. A key element of the Plan is monitoring of groundwater levels. Plan participants conduct quarterly meetings and monitoring data is disseminated annually to neighboring groundwater management agencies and the State. The Plan also includes preparation of an annual report describing water supplies and groundwater levels. By coordinating monitoring and reporting activities, plan participants are kept apprised of groundwater conditions and are able to optimize their management of available water supplies. The regular dissemination of data also serves to establish and maintain a line of communication between the Plan participants and other local or State agencies.

Historically the Tulare Lake Bed area has conjunctively managed its water supplies to maximize the importation of surface water for irrigation so groundwater usage can be minimized. These activities are documented in the annual report as Plan participants continue to use conjunctive water management in the area.

Another goal of the Plan is to preserve local management of groundwater resources in the Tulare Lake Bed area. The JPA, which allows other public and private entities to join the Plan, encourages local stakeholder involvement in managing groundwater.

Plan Participants

Alpaugh Irrigation District

Alpaugh Irrigation District (AID) was formed in March of 1915 and is located in the southeastern portion of the Plan area. Figure 2 is a location map of AID's boundary. AID obtains water from the Friant-Kern Canal as a US Bureau of Reclamation (USBR) Class II Contractor, as well as periodic flood release water known as the USBR's Section 215 water. This water can be delivered to the entire District. Deer Creek occasionally provides some unregulated waters during periods of heavy precipitation and high runoff. Deer Creek is also used as AID's conveyance facility for delivery of USBR Water. AID owns and operates eighteen wells which provide the major portion of its water supplies. The wells extend below the Corcoran clay to an average depth of 1,500 feet. AID has ponds that capture and recover local surface water supplies and provide incidental groundwater recharge.

Angiola Water District

Angiola Water District (AWD), formed in November of 1957, owns and operates all the irrigation wells within its boundaries. Figure 3 is a location map of AWD's boundaries. The wells are located in well fields owned by AWD on both the east and west sides of Highway 43. The wells east of Highway 43 are generally considered to provide better quality water. Currently, the wells have a combined pumping capacity of approximately 100 cubic feet per second (cfs). All but seven of the wells draw water from the confined aquifer below the Corcoran Clay and range in depth from 850 to 1,850 feet.

Groundwater is used to supplement AWD's surface water supplies from the State Water Project (SWP), Central Valley Project (CVP), Kings River, Tule River, Deer Creek, and residual floodwaters from Tulare Lake. As the representative of lands within its boundaries, AWD receives a percentage of Kings River Water and SWP Water from the Tulare Lake Basin Water Storage District. AWD holds a permit for diversions from Deer Creek and is one of only two permitted

appropriators thereof. Deer Creek, Tule River, and Kings River water is available to AWD dependent on the local hydrologic conditions.

Atwell Island Water District

The Atwell Island Water District (AIWD) was established in 1977. Figure 4 is a location map of AIWD's boundary. All wells within AIWD are owned and operated by the landowners or their farmer tenants. These are deep wells which are perforated below the Corcoran Clay. AIWD started receiving Federal water in June of 1978 after entering into a water service contract with the USBR, through the County of Tulare. The USBR contract provides for a maximum of 1,055 acre-feet of water to be transported annually through the San Luis Canal and California Aqueduct to the Cross Valley Canal. Rather than taking delivery from the Cross Valley Canal, AIWD exchanges its USBR water with Arvin-Edison Water Storage District and receives deliveries from the Friant-Kern Canal.

In June of 1993 AIWD, together with Hills Valley Irrigation District, entered into a contract with Tulare County for additional USBR water available for delivery within Cross Valley Canal. Through this agreement, both districts contracted for an additional 954 acre-feet of surface water annually.

AIWD has also periodically contracted for surplus USBR water through temporary water service contracts.

City of Corcoran

The City of Corcoran was incorporated in 1914. The City is approximately 7.5 square miles (4,800 acres). Figure 5 is a location map of the City limits. The California State Prison Corcoran, with approximately 5,000 inmates, and the California Substance Abuse Treatment Facility and State Prison Corcoran, with an inmate population of approximately 7,000, are included in the City limits.

The sole source of water for the City of Corcoran's municipal water service is two well fields located northeast of the City. The City currently utilizes five wells. Two other existing wells are being rehabilitated or replaced. Annual pumping from the City's wells is approximately 6,427 acre-feet. The City's service population is approximately 25,900 people, including the two Department of Corrections units and some residents located outside the City limits.

The City has voluntarily implemented a water conservation policy that includes among other provisions, prohibitions against water waste, domestic irrigation restrictions and City Manager authority to require property owners and/or water users to utilize certain restrictions on their water use.

The City provides for groundwater recharge through the operation of a storm water drainage basin and wastewater basins. The City has also required the use of treated wastewater by the California State Prison Corcoran for irrigation of alfalfa fields in-lieu of groundwater pumping.

Corcoran Irrigation District

Corcoran Irrigation District (CID) was formed in July of 1919. Figure 6 shows the location of CID. CID owns and operates storage and percolation reservoirs totaling 3,000 acres, with a surface storage capacity of approximately 10,000 acre-feet. The reservoirs can recharge up to 200 acre-feet daily and are a key part of CID's conjunctive water management program.

CID's available surface water supplies include Kings River water, Kaweah River water, and supplemental water available from the Kaweah Delta Water Conservation District and others as well. CID has a contract with the USBR to access USBR Section 215 water when available. In most years the principal source of water to CID is Kings River water derived from stock held in the Corcoran Irrigation Company, Peoples Ditch Company, and other mutual water companies on the Kings River.

CID maintains a well field of both shallow and deep wells located northeasterly of the City of Corcoran. The Corcoran Clay is approximately 50 feet thick and at a depth of 500 feet below the well field. The shallow wells tap the unconfined aquifer located above the Corcoran Clay while the deeper wells penetrate the confined aquifer below the clay and produce the majority of CID's groundwater supplies.

Lovelace Reclamation District #739

Lovelace Reclamation District #739 (LRD) encompasses approximately 5,900 acres located immediately north of Tulare Lake Basin Water Storage District. The location of the LRD's boundary is shown on Figure 7. The primary purpose of LRD is flood control. However, lands within LRD receive local surface water and State Water Project water. There are privately owned groundwater wells within the LRD boundary.

Melga Water District

Melga Water District (MWD) encompasses approximately 75,000 acres, most of which lie within the boundaries of the Tulare Lake Basin Water Storage District. MWD's boundaries are indicated on Figure 8. MWD was formed in January of 1953. Approximately 7,200 acres of MWD is outside of the Tulare Lake Basin Water Storage District's boundary in the northeastern part of the Plan area.

The surface water supplies available to lands within MWD include State Water Project water and Kings River water. Lands in MWD also periodically receive water from the Kaweah and Tule Rivers.

Privately owned and operated groundwater wells are located within MWD and provide supplemental irrigation water during water-deficient periods.

MOU Private Lands

There are approximately 10,300 acres of MOU lands within the Plan boundary as shown on Figure 9. These landowners requested that their lands be brought into the Plan because a part of their land was not included or they preferred to have all of their lands included under a single plan. Available water sources for MOU lands include local surface water, State Water Project water, and groundwater.

Salyer Water District

Salyer Water District (SWD) encompasses approximately 10,400 acres. Its boundaries are indicated on Figure 10. A portion of the acreage lies inside the boundary of Tulare Lake Basin Water Storage District with the remaining acreage located in the northeastern portion of the Plan area. Lands within SWD can receive local surface water and State Water Project water. Some privately owned groundwater wells are located within SWD.

Tulare Lake Basin Water Storage District

The Tulare Lake Basin Water Storage District (TLB) was formed in September of 1926, at which time nearly all the lands within its boundaries were in agricultural production. TLB has water and storage rights on the Kings and Tule Rivers. TLB's primary source of local surface water is considered to be the Kings River. Figure 11 is a location map of the TLB boundary.

TLB's Kings River water right is held under the Empire Weir No. 2 account and TLB is one of the twenty-eight member units of the Kings River Water Association (KRWA). This water right is erratic in nature, providing substantial water in years of moderate to heavy precipitation, while providing little or no water in years of below average precipitation. TLB's average Kings River entitlement totals approximately 58,500 acre-feet per year. Some lands within TLB also receive deliveries of Kings River water from other KRWA units (water rights).

TLB contracted with the California Department of Water Resources in 1963 to provide a more dependable surface supply for its landowners and to reduce reliance on groundwater. TLB's annual State Water Table A 2012 entitlement totals 88,922 acre-feet. Deliveries of State Water Project (SWP) water began in 1968. TLB delivers substantial quantities of surplus State Water Project water when available. TLB neither owns nor operates any wells. When sufficient surface water supplies are available almost no groundwater is pumped by TLB's water users. It should be noted that this is true for most of the Plan participants.

Tulare Lake Reclamation District #761

Tulare Lake Reclamation District #761 (TLRD) encompasses approximately 35,000 acres, nearly all of which lie within the boundary of Tulare Lake Basin Water Storage District. Figure 12 is a location map of the TLRD boundary. Lands within TLRD can receive local surface water and State Water Project water. TLRD 's average Kings River entitlement is approximately 24,500 acre-feet per year. There are some privately owned groundwater wells within TLRD's boundary.

II. MANAGEMENT AREA

Location

Figure 1 is a location map of the Coordinated Groundwater Management Plan (Plan) area boundary. The Plan area is roughly bounded by the Kings County line on the east, Interstate 5 and Highway 41 on the west, Lansing Avenue on the north, and Wichita Avenue on the south (also Tulare Lake Basin Water Storage District's Lateral B Canal). Some participants' boundaries extend beyond this rough perimeter.

Climate and Hydrology

The climate in the region is typical of the southern San Joaquin Valley. The Tulare Lake Bed region is semi-arid. Average annual rainfall is 7.4 inches. Spring seasons are usually mild with some wind, summers are hot and dry, autumns are cool, and winter seasons are typically characterized by fog and rain with temperatures seldom dropping below the freezing point.

Corcoran Irrigation District measures and records precipitation and maximum and minimum temperatures at a station near the eastern boundary of the Plan area. Historic data from this site is presented as follows in Tables 1 and 2. Average monthly rainfall varied from 0 to 1.47 inches. Approximately 70% of the rainfall typically occurs during the months of December through March. Average maximum and minimum temperatures occur respectively during July and December.

Table 1
Average Precipitation from 1931 to 2011

Month	Average Precipitation (inches)
January	1.47
February	1.44
March	1.18
April	0.68
May	0.22
June	0.04
July	0.01
August	0.03
September	0.14
October	0.37
November	0.69
December	1.16
Average Annual Precipitation	**7.42**

Source: Corcoran Irrigation District records

Table 2
Average Maximum and Minimum
Monthly Temperatures from 1948 to 2010

Month	Average Maximum Temperature (°F)	Average Minimum Temperature (°F)
January	55	37
February	62	40
March	68	43
April	76	47
May	85	53
June	93	59
July	99	63
August	97	62
September	91	57
October	81	49
November	66	41
December	55	36

Source: Corcoran Irrigation District records

The Plan area is a “closed” basin with no natural outlet. No natural outflow from the historic Tulare Lake has occurred since the late 1870’s. This is a result of upstream diversions of the four major river tributaries on the east side of the San Joaquin Valley and the U.S Army Corps of Engineers flood control projects on these tributaries. However, during years of above normal runoff, floodwaters can inundate highly productive farmland within the Plan area. On average, some flooding occurs during one of every four to five years.

Land Use

The majority of land in the Plan area is used for irrigated agriculture. Typical crops grown in the area include tomatoes, wheat, barley, safflower, alfalfa, and cotton. There are some nut orchards, but these are much less prevalent than row crops. There are a number of dairies in the northerly and easterly regions of the Plan area. Urban land use is minor in comparison to the overall Plan area. The largest urban area is the City of Corcoran and the nearby California State Prison Corcoran. Alpaugh is a small community located near the southeast corner of the Plan area.

Water Resources and Supplies

Water resources and supplies for the Plan area include various surface water sources and groundwater. The descriptions of individual Plan participants found in Chapter 1 indicate specific supplies that are available to participants.

Surface Water

Surface water supplies are generally derived from participant and landowner water rights on the Kings, Kaweah, and Tule Rivers, State Water Project (SWP) contracts, and US Bureau of Reclamation (USBR) contracts. Water is occasionally available from Deer Creek. Water users in the Plan area also acquire additional local surface water supplies when available. Floodwater,

which occurs infrequently, is impounded by the landowners in the southern and northeastern parts of the Plan area.

The Kings, Kaweah, Tule, and Kern Rivers originate in the southern Sierras east of the Plan area. These four major rivers are regulated by dams and reservoirs constructed by the US Army Corps of Engineers in the 1950's and 1960's. Smaller uncontrolled streams, including Deer Creek, Poso Creek, and the White River, provide erratic flows during flood periods. The Kings River is the primary source of surface water into the Plan area. Kings River water is delivered to the Plan area from the northeast through the Lakeland Canal, from the northwest through the South Fork of the Kings River, and through other privately owned canals. Tule River water is delivered to the Plan area from the east. The Kern River enters the Plan area from the south and the Kaweah River enters from the northeast.

In very wet years floodwater entering the Plan area can inundate Tulare Lake Bed lands. Flooding of cropland occurs an average of one in four to five years. During extreme flooding periods the four principal rivers, smaller uncontrolled streams, and arroyos on the west side of the San Joaquin Valley can all flow into the Plan area. Residual floodwaters in Tulare Lake Bed are used to the maximum extent possible for irrigation. Floodwater not used for irrigation is lost primarily to evaporation.

Local river water supplies vary greatly from year to year depending on hydrologic conditions. Flood releases can occur on the four major rivers at times of above average runoff. Since the Tulare Lake Bed is a closed basin, inundation of cropland leads to decreased demand for surface water supplies. The inundation and decreased demand typically occur at the same time there are flood releases from east side reservoirs. Subsequently an even greater proportion of the total reservoir releases is lost through flood releases. More reservoir capacity would permit the flood water to be stored and conserved

providing increased surface water deliveries in subsequent years, thereby resulting in less groundwater pumping. Plan participants actively pursue projects that will increase local surface water storage.

Groundwater

The Plan area overlies the southern portion of the Tulare Lake Groundwater Basin (TLGB). The TLGB has been described in studies conducted by the Department of Water Resources and the United States Geological Survey. Generally, the TLGB consists of a shallow aquifer and a deep aquifer separated by a hydrogeologic formation known as the Corcoran Clay. The Corcoran Clay layer varies from approximately 50 to 200 feet in thickness, and occurs at depths of 400 to 600 feet. The soil profile above and below the Corcoran Clay layer consists of very dense clay as well. The soils that underlie the Plan area are primarily low water bearing, fine textured clay materials with interspersed lenses of silty sand. These relatively impermeable soils limit direct recharge of the shallow aquifer.

Shallow groundwater in the interior of the Plan are has high concentrations of salts and is not suitable for agricultural purposes. Shallow wells in the Plan are located at the edges of the historic lake bed.

<u>Geology</u>

Figure 13 is a location map of the Tulare Lake Bed and a corresponding geologic cross section through the Plan area. The cross section indicates the elevation and thickness of major geologic formations along the cross section line. This information was sourced from the U.S. Geologic Survey Water Supply Paper (WSP) 1999-H, which includes detailed technical descriptions of the southern San Joaquin Valley's subsurface geology. A general description of the Plan area topography and geology is provided as follows.

The topography is a gradually sloping trough from the area's outer boundary toward the lowest region in the Tulare Lake Bed, which lies at approximately 175 feet above mean sea level (MSL). The generally flat terrain has an average slope of about one-foot per mile.

The soils in the historic lake bed are primarily impermeable clays. Soils along the rim of the historic lake bed are primarily fine grained, silty alluvium which were deposited along the shoreline. Older Continental alluvium deposits have noticeably finer texture than the younger Sierra Nevada deposits, which are highly permeable and consist of gravel, fine to very coarse sand, and silt. The alluvium deposits interfinger with clay layers near the Plan area boundary, and diminish approaching the interior of the lake bed. Areas near the center of the lake bed are almost entirely clay strata.

Groundwater Levels

The numeric depth to groundwater data presented herein dates to 1994. From 1994 to 2010, depth to water measurements were collected from a group of 28 wells within the Plan area. In 2011 the monitoring program was reorganized to conform with the California Statewide Groundwater Elevation Monitoring (CASGEM) program. A group of 16 wells was selected as being representative of conditions in the Plan area. Ground and well head elevations were surveyed and tied-in to a statewide elevation datum so groundwater elevations can be determined from the depth to water readings of the wells. Approximately 10 of the 16 CASGEM wells were in the original group of 28 wells. Table 3 indicates the average depth to water readings in the Plan area from 1994 to 2011. The data is separated into average readings for the shallow and deep wells that are monitored. Shallow wells are perforated above the Corcoran clay and deep wells are perforated below the Corcoran clay. Over the period of record, the average depth to water has ranged from about 70 to 175 feet for the upper aquifer and 110 to 310 feet for the lower aquifer.

Table 3
Depth to Static Water in Plan Area

Year	Shallow Well Average in feet		Deep Well Average in feet	
	Spring	Fall	Spring	Fall
1994	130		250	
1995	87		145	
1996	85		135	
1997	142	90	169	172
1998	82	65	120	116
1999	67	69	110	146
2000	75		150	
2001	132	103	242	267
2002		91	266	209
2003	121	118	256	260
2004	126		254	
2005			257	
2006				
2007	146	141	271	259
2008	156	175	274	289
2009	147	176	268	313
2010	150	147	285	269
2011	127	118	213	213

Depth to water readings in the Plan area fluctuate up and down in response to hydrologic conditions and the availability of imported surface supplies. Figure 14 is a chart that illustrates these trends from water years 1993-94 to 2010-11.

Table 4 is a listing of the CASGEM wells and elevation data for each well site, and Figure 15 is a location map of the CASGEM wells. Beginning in the fall of 2011 these wells will be measured two times per year and the groundwater elevation data will be reported to the designated regional monitoring entity, Kings River Conservation District, and ultimately to the State.

Table 4
CASGEM Well Information

Well No.	Latitude	Longitude	Groundwater Subbasin	Reference Elevation	Ground Elevation
Shallow Wells					
2	36.17	-119.67	Tulare Lake	197.0	195.3
4	36.20	-119.58	Tulare Lake	210.2	207.4
9	36.13	-119.55	Kaweah	203.2	199.1
11	36.09	-119.47	Kaweah	211.6	210.2
14	35.99	-119.49	Tule	188.8	187.4
Deep Wells					
1	36.17	-119.88	Tulare Lake	205.7	202.7
3	36.17	-119.69	Tulare Lake	195.6	193.1
5	36.19	-119.58	Tulare Lake	209.1	206.7
6	36.14	-119.89	Tulare Lake	199.9	196.9
7	36.06	-119.78	Tulare Lake	176.6	176.4
8	36.09	-119.66	Tulare Lake	179.8	177.2
10	36.07	-119.61	Tulare Lake	182.0	180.2
12	36.09	-119.46	Kaweah	212.3	211.3
13	36.04	-119.59	Tulare Lake	182.2	181.3
15	35.96	-119.48	Tule	185.3	184.3
16	35.91	-119.45	Tule	199.0	197.5

Water Quality

Surface water supplies to the Plan area are of excellent quality due to low total dissolved solids (TDS). Kings River supplies have TDS of approximately 100 parts per million (ppm) and State Project water TDS is about 250 ppm. Well water in the Plan area generally has higher TDS than Kings River surface water and is comparable to State Project water. Kings River and State Project water typically ranges from 100 to 300 ppm. Most of the groundwater wells range in TDS from 150 to 500 (ppm).

The City of Corcoran, which is the only Plan participant that relies exclusively on well water for its supplies, monitors and reports its source water quality in accordance with Title 22 requirements for potable water systems.

III. GROUNDWATER MANAGEMENT PLAN COMPONENTS

This chapter summarizes the components of the Coordinated Groundwater Management Plan (Plan). Components that are recommended for SB1938 compliance but are not applicable to this Plan, are also identified.

Saline Intrusion

Saline intrusion of the groundwater aquifer is not a concern in the Plan area.

Management of Wellhead Protection Areas

Wellhead protection areas, if such areas exist, are managed in accordance with County requirements.

Regulation of Migration of Contaminated Groundwater

There are no known issues related to the migration of contaminated groundwater within the Plan area.

Well Abandonment and Destruction

Well abandonment and destruction within the Plan area are conducted in accordance with County requirements.

Existing Groundwater Management and Conjunctive Use Activities

As stated elsewhere in the Plan, direct recharge is limited due to the geologic conditions throughout most of the Plan area. However, most participants use surface water supplies whenever possible in-lieu of groundwater pumping. Conjunctive management of local water resources, including surface water through indirect or in-lieu recharge, has been practiced in the Plan area for nearly a century. Groundwater levels that have declined during dry periods typically recover when adequate surface water supplies are available to the Plan area.

Direct Recharge

The confined and unconfined aquifers underlying the Plan area are primarily recharged from seepage from rivers and irrigation facilities on the east side of the San Joaquin Valley. Corcoran Irrigation District (CID) owns ponding basins in the northeastern corner of the Plan area which are used to provide direct recharge primarily to the unconfined aquifer above the Corcoran clay with limited benefit to the lower aquifer. CID uses the ponds for direct recharge when excess surface water is available, typically during years with above average runoff.

Surface Storage

Landowners can store water in ponds at the south end of the Tulare Lake Bed. These ponds are located on land that is marginal for farming and not suitable for direct recharge. When floodwater enters the Lake Bed from the various tributary rivers and creeks, and it threatens to inundate prime farmland, the water is diverted into these storage ponds using a system of ditches and pumps. As irrigation demands increase, the water stored in the ponds is used for irrigation in-lieu of groundwater pumping.

State Water Project

Irrigating with imported surface water supplies minimizes groundwater pumping and recharges the groundwater aquifers through indirect or in-lieu recharge. Erratic local river supplies and the desire to reduce groundwater pumping motivated Tulare Lake Basin Water Storage District (TLB) to enter a contract for State Water Project (SWP) water in the early 1960's. Two diversion points and canals were constructed from the California Aqueduct to the west side of the Plan area. From 1968 through 2011, more than 4.5-million acre-feet of irrigation water was imported into the Plan area from the California Aqueduct. Although the cost of imported surface water is frequently higher than the cost of pumping groundwater, growers in the Plan

area continue to purchase and deliver this water to reduce their reliance on groundwater.

Empire Weir No. 2 Pool

TLB is also active in water exchange programs using its delivery facilities from the Kings River and California Aqueduct. The District does not have major surface storage or groundwater banking capabilities. However, Kings River water is received through the Empire Weir No. 2 pool, which has about 400 acre-feet of temporary storage capacity.

Kings County Exchange

The County of Kings is a SWP Contractor but it has no direct connection from the California Aqueduct to deliver its SWP water. The TLB entered into an exchange agreement with the County of Kings in 1967. Through that agreement TLB accessed 4,000 acre-feet per year of the County's contract supply from the Aqueduct in exchange for an equivalent amount of Kings River water.

In 1979, the County determined it could no longer afford the cost of the SWP water and therefore entered into an agreement with various water agencies in the area to sell them the exchanged Kings River water for the cost of maintaining the County's SWP contract. The water agencies were willing to pay for this supply to offset groundwater pumping and not lose this imported water supply. The original agreement has since been amended several times and the current exchange amount is 3,100 acre-feet.

Urban and Prison Water Use Mitigation Program

The City of Corcoran and the California State Prison Corcoran rely solely on groundwater for their water supplies. To offset impacts on groundwater, the City and prison contribute annually to a mitigation fund. Under the Plan the mitigation fund can be used to purchase and divert affordable surface water

to CID's recharge ponds, which are located near the City's well field. Alternatively, growers in CID can receive surface water purchased through the mitigation fund in lieu of operating their irrigation wells. Approximately 12,250 acre-feet of surface water has been purchased under this program since it began.

Drought Year Surface Water Purchases

TLB also purchases surface water supplies for conjunctive use. During dry years, District water users purchased Yuba County Water Agency Water, California Drought Water Bank Water, and SWP Supplemental Short Term Water Purchase water for delivery from the California Aqueduct.

These programs demonstrate Plan participants' cooperation and coordination with each other to optimize and manage their groundwater supplies. In years when surface water from local rivers or other imported surface water is available, groundwater use is reduced and indirect recharge occurs. In dry years groundwater supplies are used. Figure 14 is a chart that graphically illustrates the effectiveness of these programs. The chart shows how the proportion of surface water and groundwater use varies depending on hydrologic conditions, and the responsiveness of groundwater levels when surface supplies are abundant and groundwater pumping is reduced.

Monitoring of Groundwater Levels and Storage

A key component to the Plan is monitoring of groundwater levels within the Plan area. Collection and dissemination of this data was recently reorganized to conform with the California Statewide Groundwater Elevation Monitoring (CASGEM) program. Under this program, a group of 16 representative wells was selected. Figure 15 is a location map of the wells. The well location symbols and map legend indicate if the wells are perforated above or below the Corcoran clay layer.

To conform with the CASGEM program, the selected well sites were surveyed and the elevations were tied-in to a statewide elevation datum. Included in the survey were the elevations of the natural ground adjacent to the wells, bench marks on the well head concrete pads, and measurement reference points on the sounding tubes.

The well owners are responsible for measuring their respective CASGEM wells during the spring and fall each year. Depth to water measurements are taken after the well pumps have been turned off for a period of time to allow the water level to stabilize. These readings are submitted to the Plan administrator, TLB, which processes all the CASGEM data and submits it in an electronic format to the designated reporting agency, Kings River Conservation District (KRCD).

Monitoring of Groundwater Quality

Owners of the CASGEM wells periodically test their well water for electrical conductivity (EC) which relates to the total dissolved solids in the water. EC measurements will be logged by TLB acting as Plan administrator.

Monitoring of Surface Flow and Surface Water Quality Relative to Groundwater and Groundwater Pumping

Surface soils in the Plan area are primarily semi-permeable to impermeable, and the depth to usable groundwater, if any, is far below the ground surface or any canals or stream beds within the Plan area. Surface flow does not comingle with the usable groundwater and therefore does not affect groundwater quality or quantity. The naturally high concentration of salts in the perched groundwater precludes its use for irrigation or municipal uses.

Monitoring and Management of Inelastic Land Surface Subsidence

Plan participants are currently reviewing options for monitoring land subsidence. One option would be to establish a set of reference points

throughout the Plan area and perform periodic elevation surveys of the points. The reference points could be located on canal structures or other permanent concrete structures that are at least several years old and have undergone most of the settlement that is typical following construction. Since these types of structures are founded near the ground surface, changes to their elevation would be approximately the same as the surrounding ground. Monitoring of the reference points could also include an assessment of how changes in ground elevations might affect surface flows in the Plan area.

Well Construction Policies

Wells constructed within the Plan area are done in accordance with County and State Department of Water Resources requirements.

Construction and Operations of In-Lieu Recharge, Storage, Conservation, Water Recycling, and Extraction Projects

As previously discussed, many of the Plan participants have constructed and operated projects related to storage, conservation, water recycling and extraction.

Angiola Water District Projects

Angiola Water District (AWD) continues to research a number of projects involving their system which would benefit groundwater in the Plan area. These projects are presented conceptually as follows and will require additional investigations to determine their feasibility.

Surface Storage Basins

AWD has a system of production wells and ditches located just west of Highway 43. The land surrounding the wells is marginal ground that is not continuously farmed and it encompasses most of three sections (3 square miles). Two of the sections are partially owned by AWD and the third is held by a private owner. The well system ditches are generally located along the

perimeter of the parcels. It is proposed that earthen levees be constructed on the land for storage basins. Floodwater from Deer Creek could be diverted into the proposed basins. Instead of pumping groundwater, water stored in the basins could later be released into the existing well system ditches for AWD's irrigation demands.

Injection Wells

There are a number of locations within the above described AWD well field where existing wells have been retired and new wells were constructed within a few hundred feet or less. The wells were retired because the casings deteriorated and were no longer suitable for pumping. These casings might still be utilized to inject surface water into the aquifer. This may be done by connecting the existing well system ditches to the injection wells and using water stored in the proposed basins for direct recharge. It might also be possible to divert surface water to the injection wells from other parts of the Plan area using AWD's main delivery ditch.

Groundwater Conservation Easement

Another concept or related concepts being considered by AWD is a groundwater conservation easement or land fallowing program which result in reducing groundwater pumping.

Other Projects

Another concept which has been discussed by the Plan participants would be a program to flood fallowed land for temporary storage. As with AWD's proposed storage basins, this program would require construction of earthen berms or levees to contain the floodwater, and coordination among the Plan participants to divert floodwater to the designated areas.

Relations with Local, State, and Federal Regulatory Agencies

Under the Plan, participants attend regular quarterly meetings. These meetings provide a forum for the Plan administrator, TLB, to report on groundwater and surface water conditions, review conjunctive management activities being implemented by other Plan participants, and review regulations that could affect groundwater use and management. The meetings also provide an opportunity for Plan participants to meet and coordinate with other local water management agencies such as Kaweah Delta Water Conservation District.

The participants submit groundwater elevation data to TLB and the District disseminates the data to Kings River Conservation District (KRCD) and the State Department of Water Resources. KRCD is the designated reporting agency for the Plan under the State's SBx7-6 California Statewide Groundwater Elevation Monitoring (CASGEM) program. Data for this program is submitted semi-annually.

The formation of the Plan participants under the Joint Powers Agreement and their ongoing participation in monitoring groundwater and attending the quarterly meetings demonstrates the effectiveness of the coordinated plan approach being used for groundwater management in the Tulare Lake Bed.

Land Use Planning

Land use planning in the Plan area is done in accordance with County and City General Plans and zoning ordinances.

IV. MANAGEMENT OBJECTIVES

The primary objectives of the Coordinated Groundwater Management Plan are listed as follows.

- Monitor groundwater levels and disseminate data to plan participants.
- Maintain relationships with local and State agencies.
- Define opportunities for sustaining local groundwater supplies, including enhancing conjunctive use.
- Enhance existing conjunctive use through operational programs to import additional surface water and capital projects to increase surface water use and groundwater storage.

V. MONITORING

Following are the monitoring protocols for the Coordinated Groundwater Management Plan:

Groundwater Levels

- California Statewide Groundwater Elevation Monitoring (CASGEM) program.
- CASGEM Well locations indicated on Figure 15.
- Designated well owners measure depth to groundwater in spring and fall.
- Measurements taken when well is not being pumped and level has stabilized.
- Measurements are transmitted to Tulare Lake Basin Water Storage District (TLB).
- TLB processes data and transmits summary of depth to water and water elevations to Kings River Conservation District (KRCD).
- KRCD forwards groundwater level data to California Department of Water Resources.

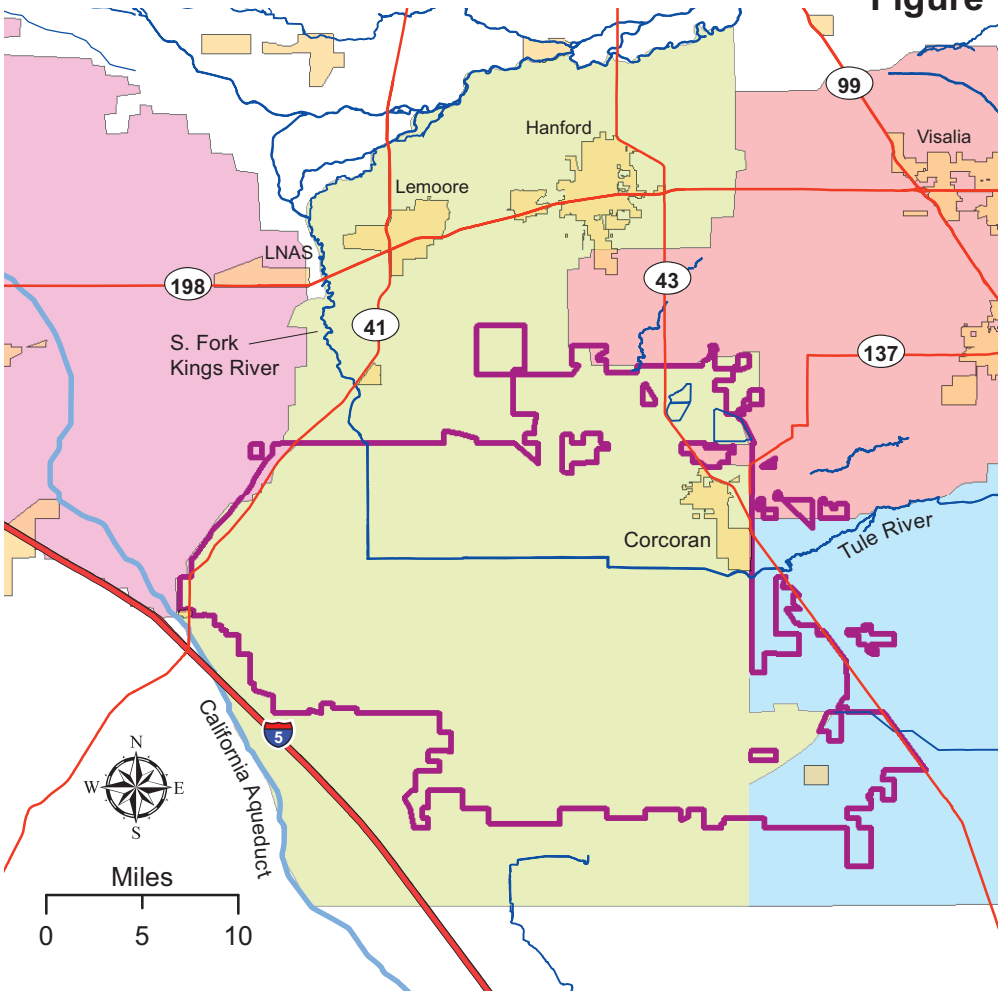
Groundwater Quality

- CASGEM well owners periodically test well water for electrical conductivity (EC).
- Samples taken after well has been pumped for a short time.

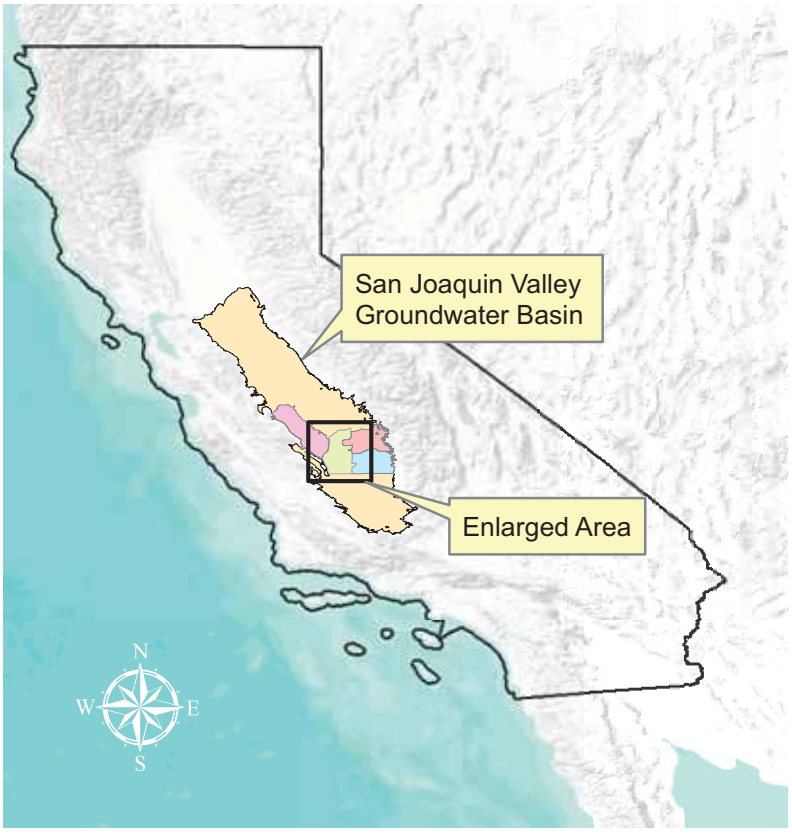
Inelastic Land Subsidence

- Monitoring program currently under review by Plan participants.

Figure 1



ENLARGED AREA



STATE OF CALIFORNIA

Legend

- Interstate Highway
- State Highway
- Rivers
- **Canals**
- **Plan Area Boundary**
- Westside Groundwater Sub-basin
- Tule Groundwater Sub-basin
- Tulare Lake Groundwater Sub-basin
- Kaweah Groundwater Sub-basin

Tulare Lake Bed Coordinated Groundwater Management Plan Plan Area Location Map

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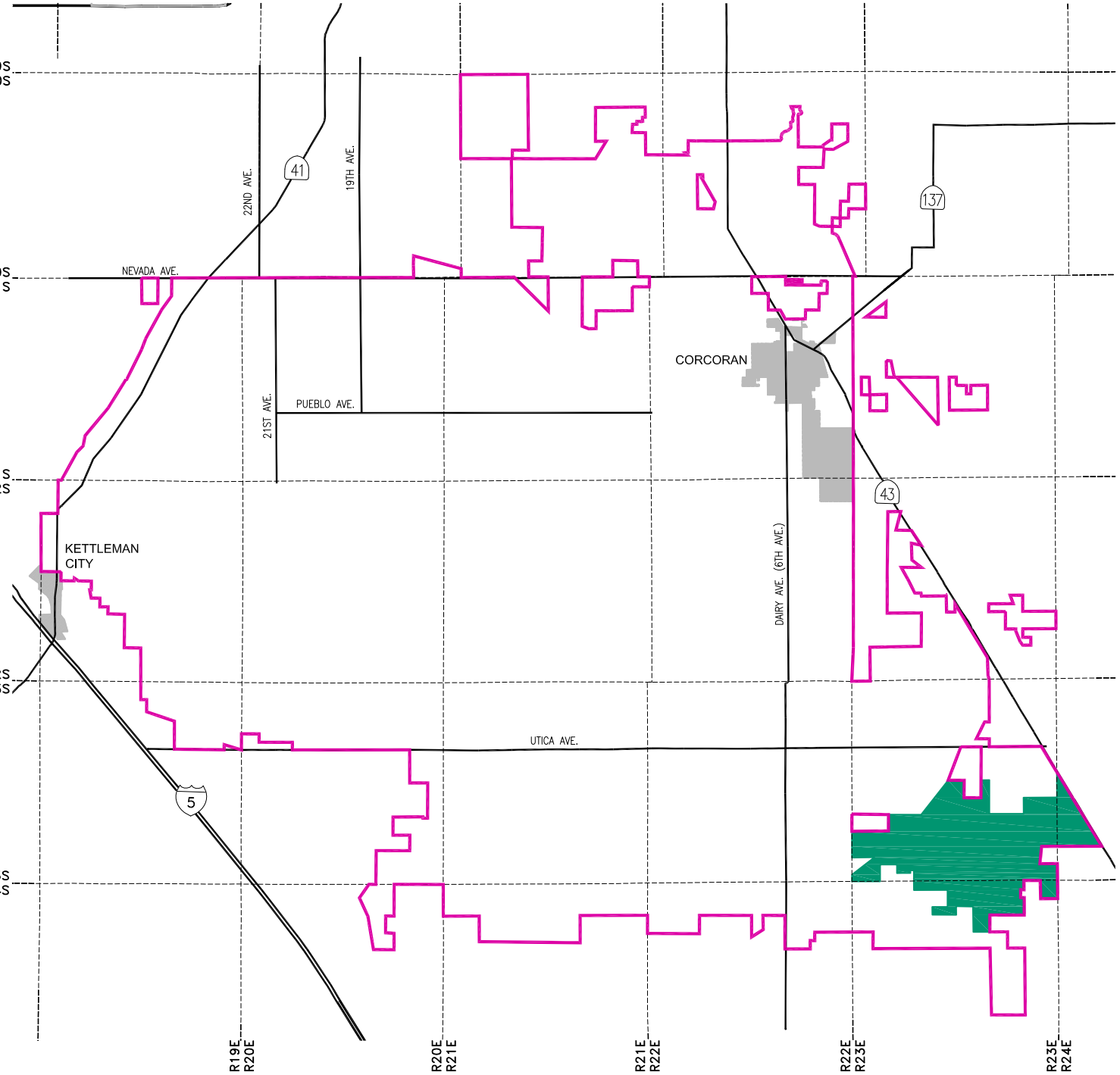
Consulting Engineers
Hanford California

FIGURE 2



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- ALPAUGH IRRIGATION DISTRICT

SCALE IN MILES
0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

ALPAUGH IRRIGATION DISTRICT LOCATION MAP

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HANFORD CALIFORNIA

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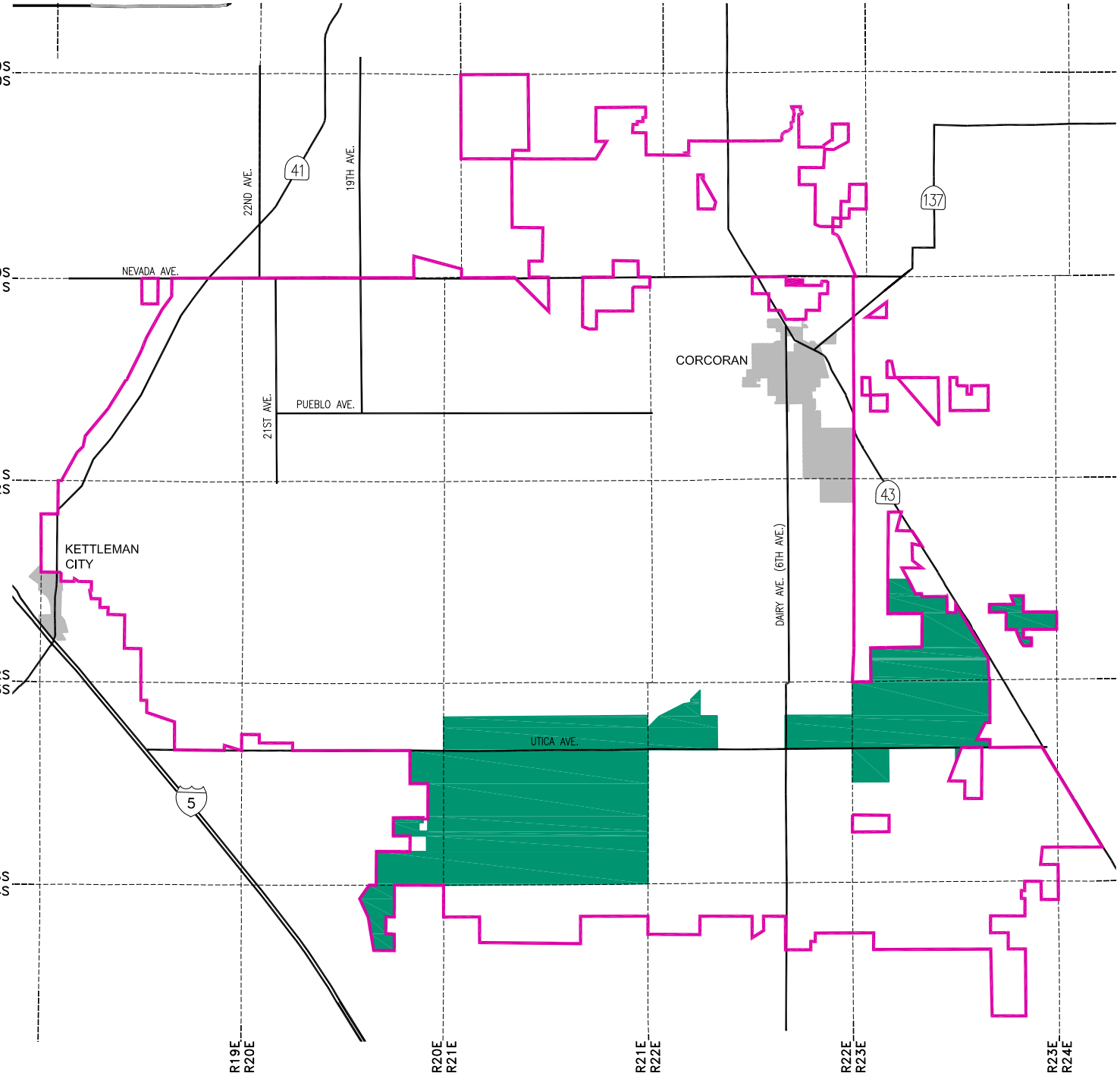
FIGURE 3



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- ANGIOLA WATER DISTRICT

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

ANGIOLA WATER DISTRICT LOCATION MAP

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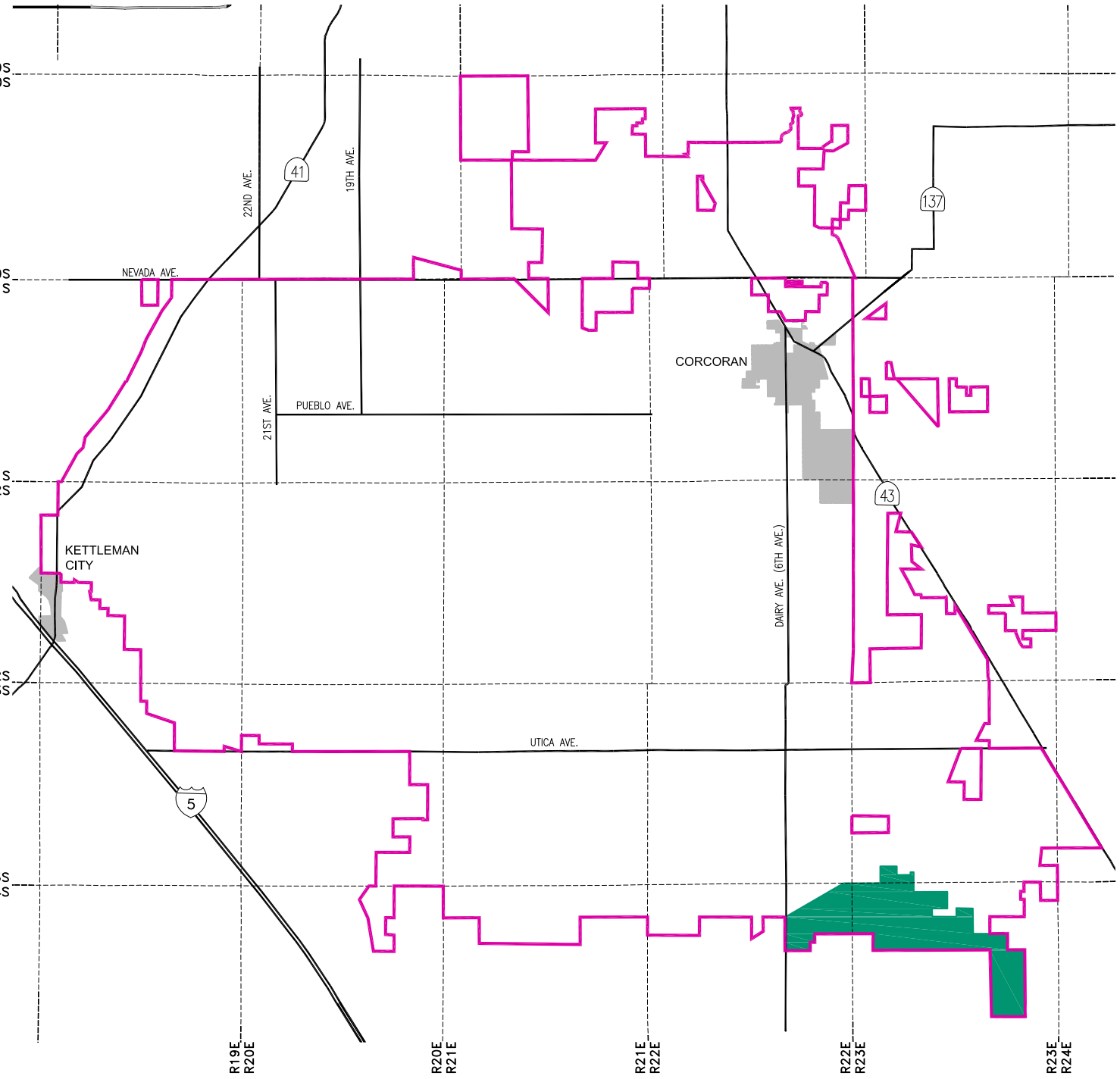
FIGURE 4



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- ATWELL ISLAND WATER DISTRICT

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

ATWELL ISLAND IRRIGATION DISTRICT LOCATION MAP

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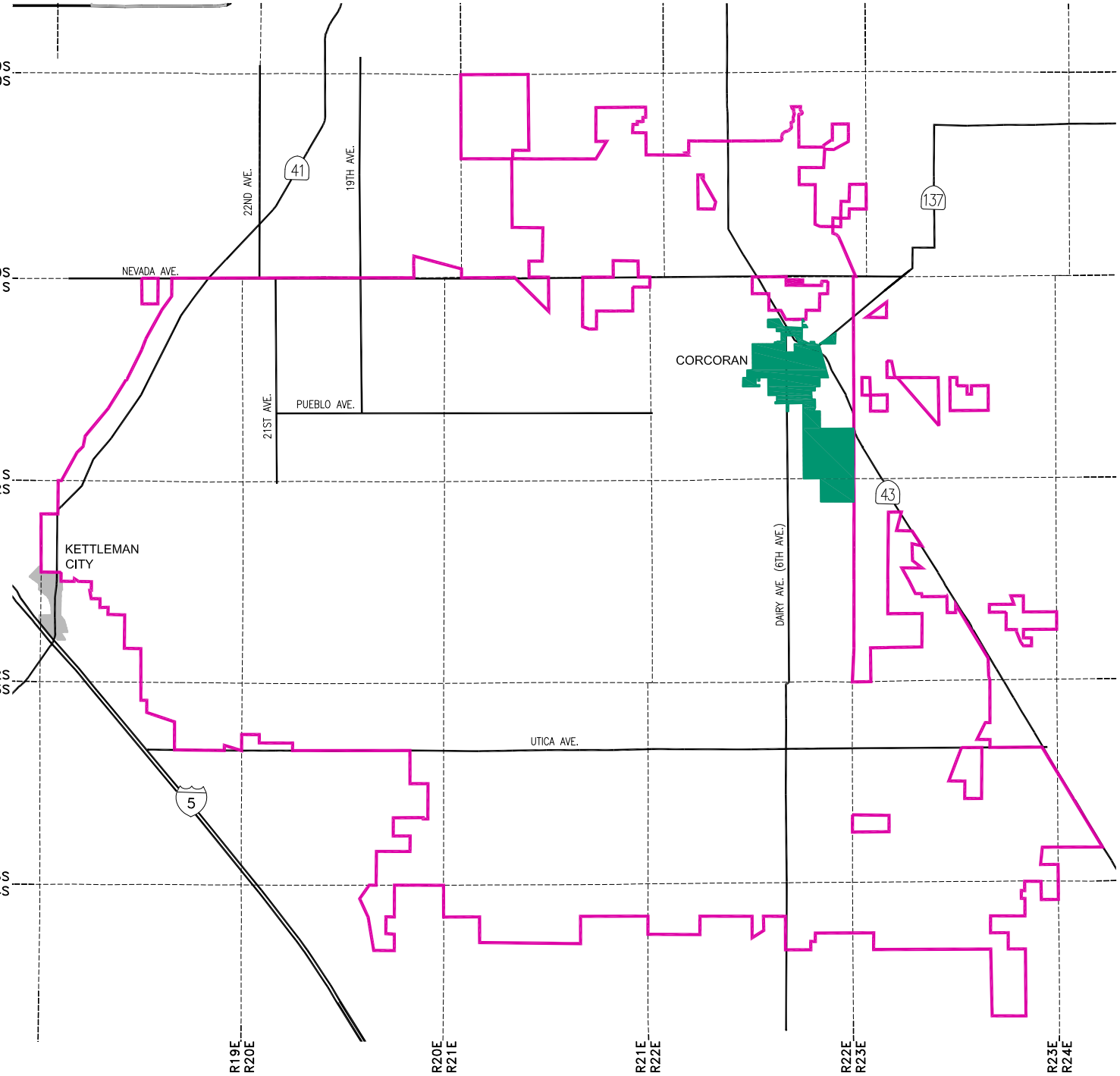
FIGURE 5



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- CITY OF CORCORAN

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

CITY OF CORCORAN LOCATION MAP

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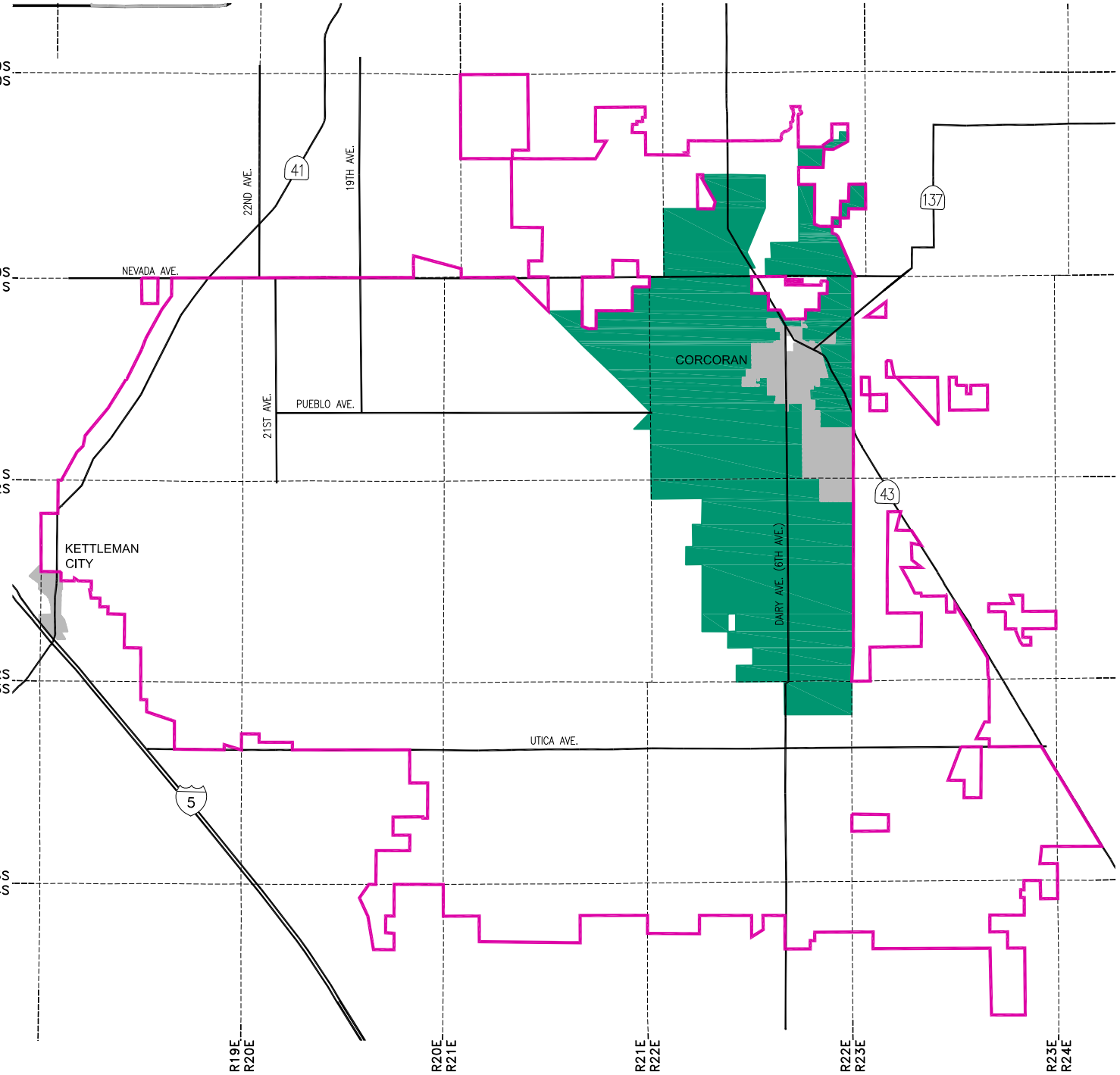
FIGURE 6



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- CORCORAN IRRIGATION DISTRICT

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

CORCORAN IRRIGATION DISTRICT LOCATION MAP

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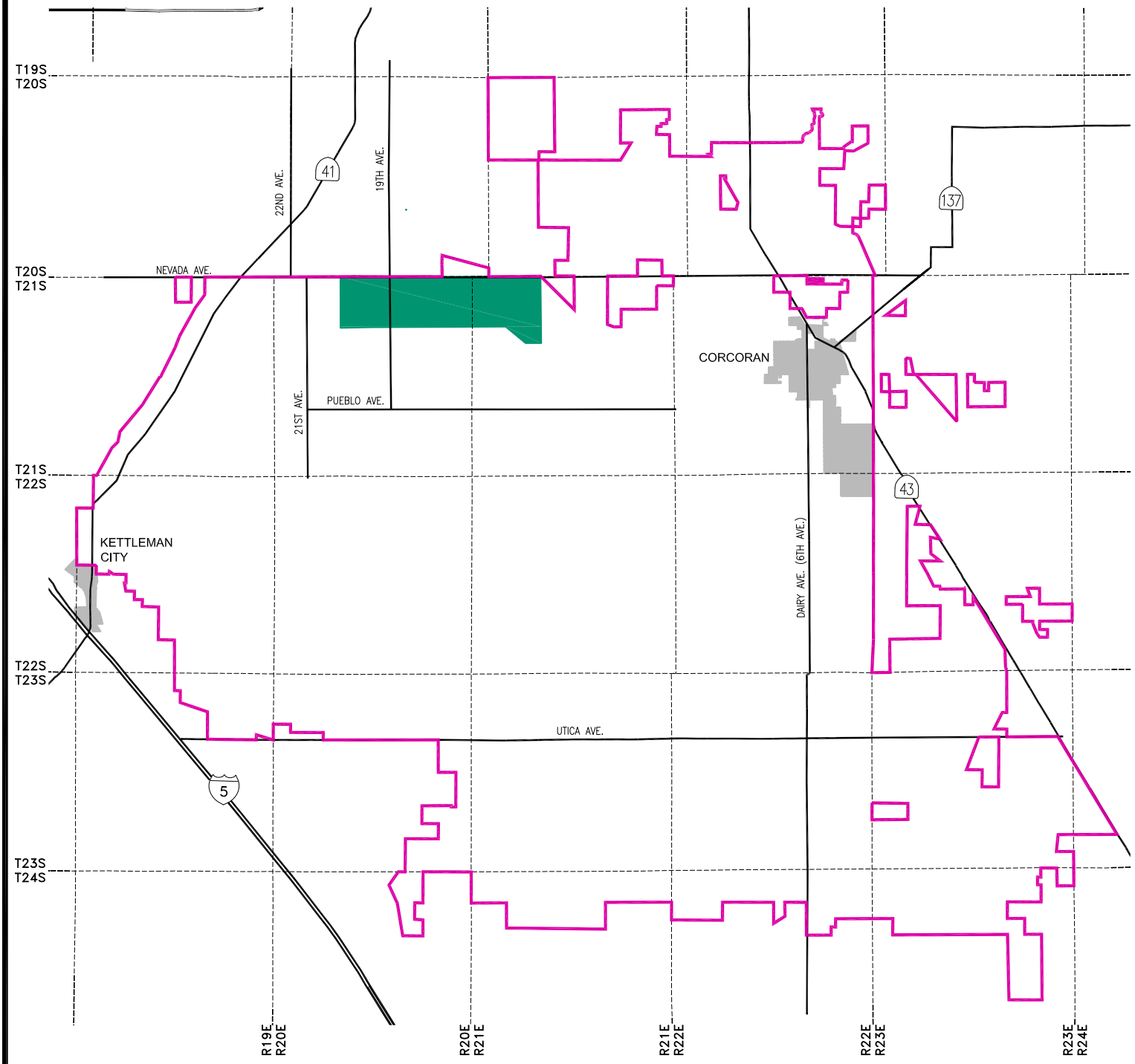
FIGURE 7



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- LOVELACE RECLAMATION DISTRICT #739

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

LOVELACE RECLAMATION DISTRICT #739 LOCATION MAP

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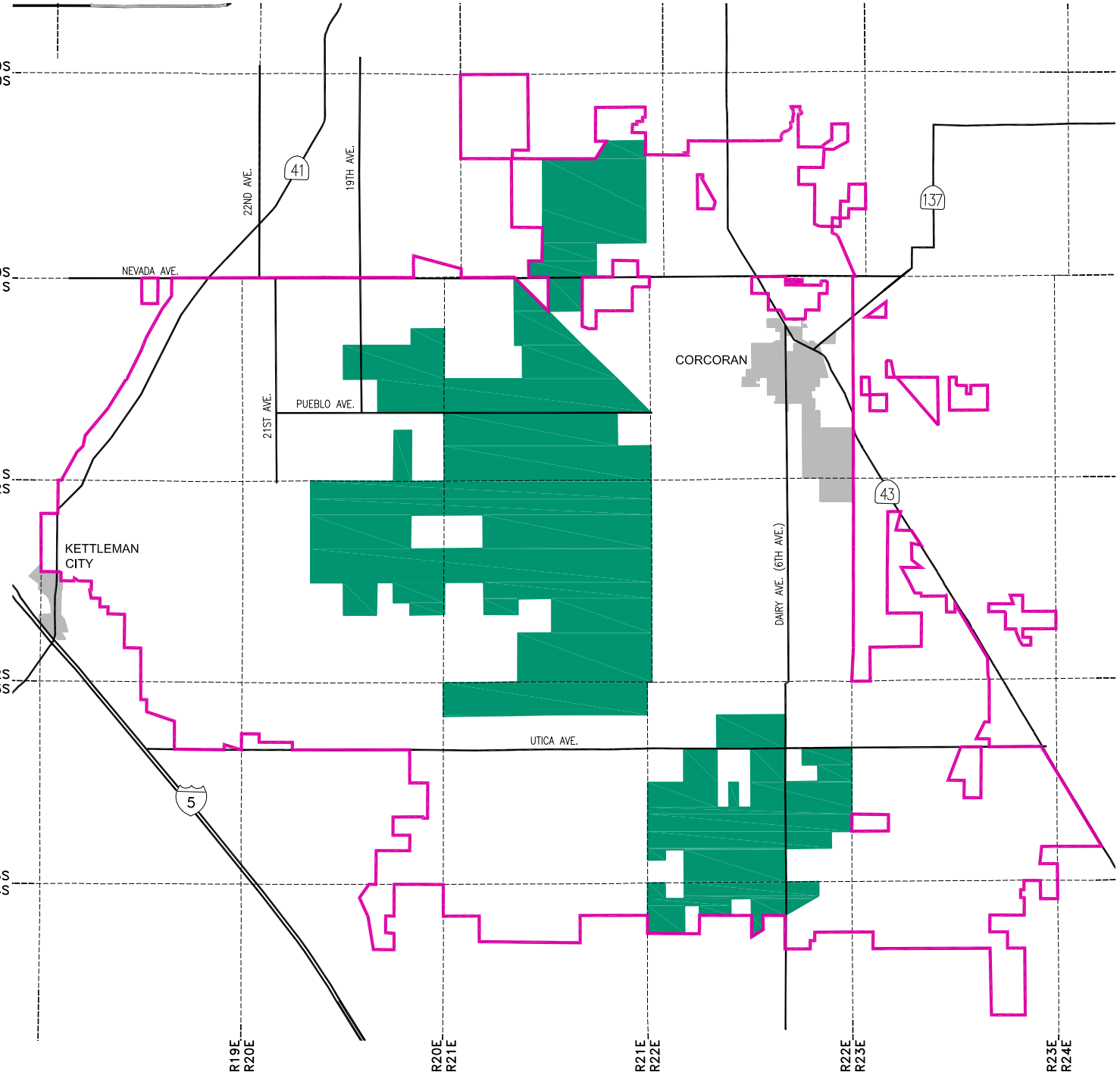
FIGURE 8



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- MELGA WATER DISTRICT

SCALE IN MILES
0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

MELGA WATER DISTRICT LOCATION MAP

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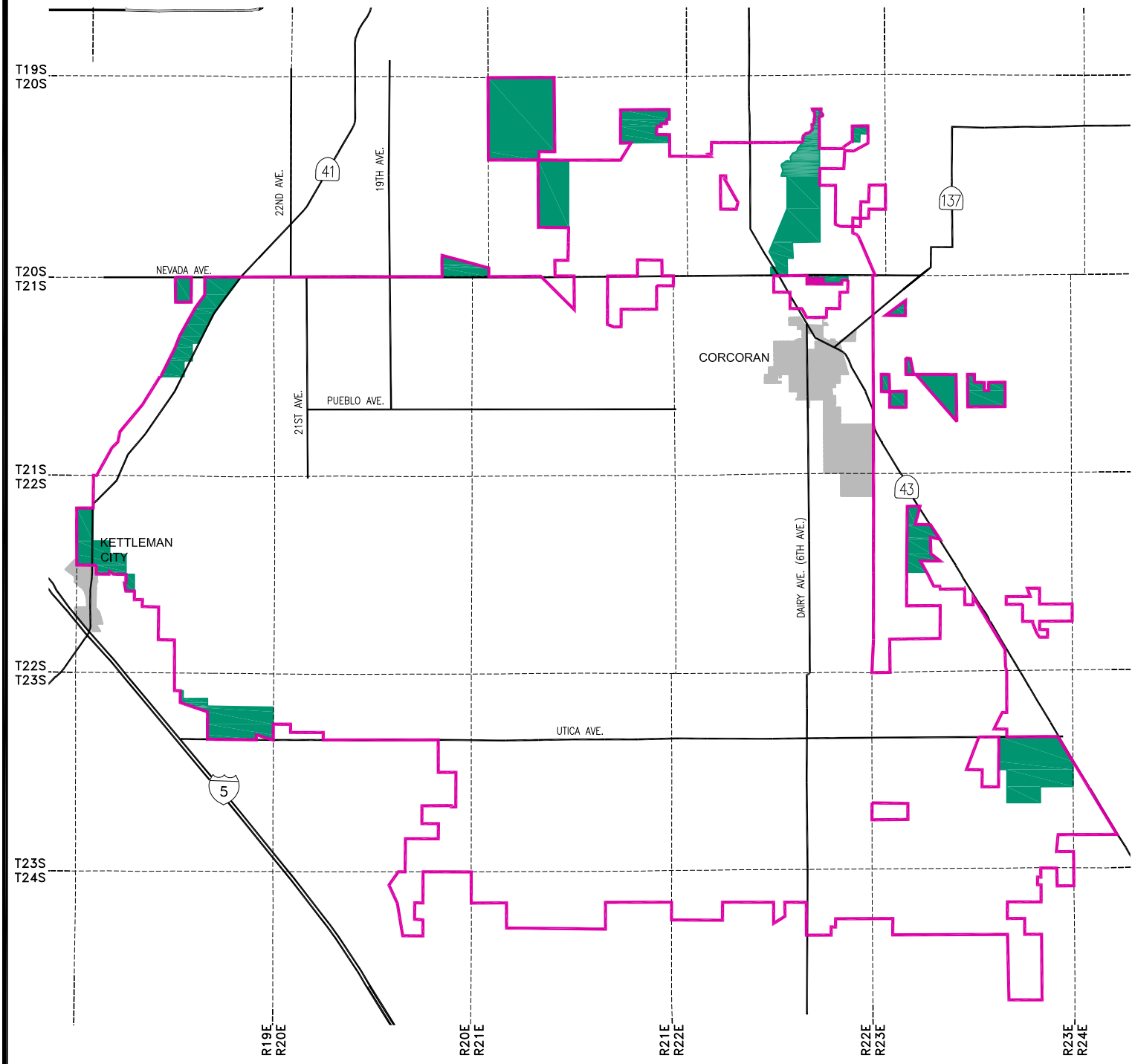
FIGURE 9



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- MOU PRIVATE LANDS

SCALE IN MILES
0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

MOU PRIVATE LANDS LOCATION MAP

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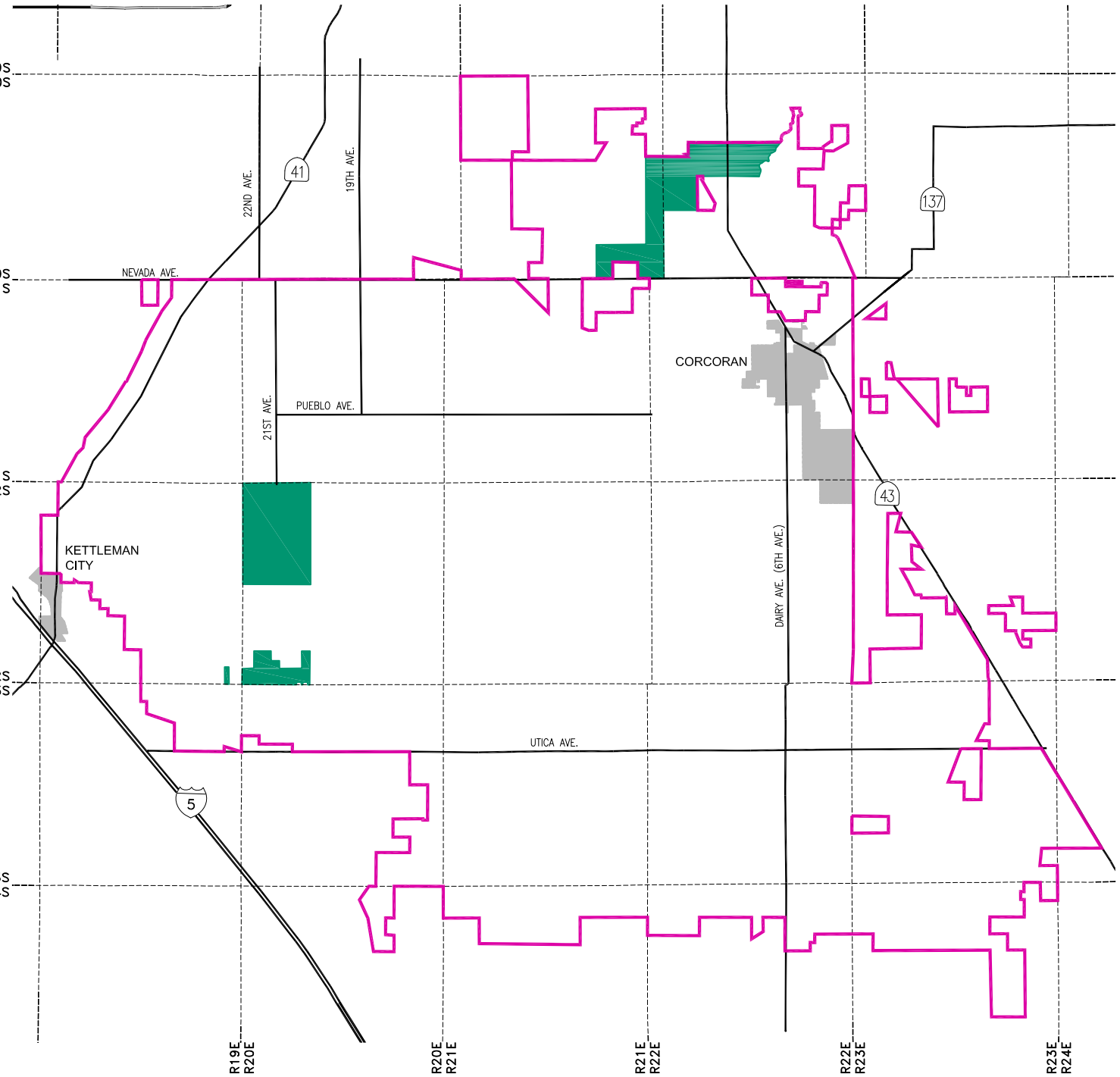
FIGURE 10



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- SALYER WATER DISTRICT

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

SALYER WATER DISTRICT LOCATION MAP

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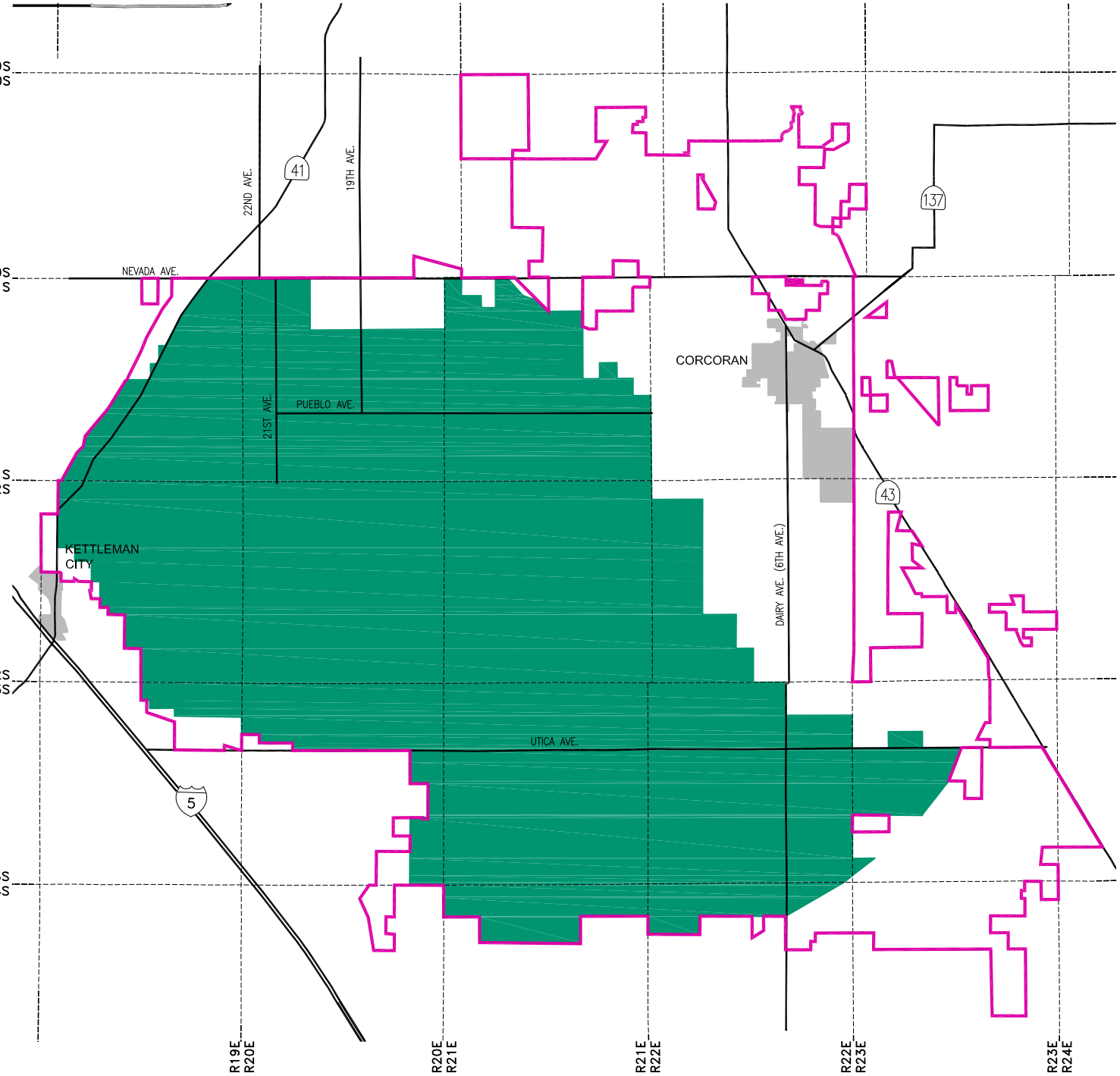
FIGURE 11



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- TULARE LAKE BASIN WATER STORAGE DISTRICT

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

TULARE LAKE BASIN WATER STORAGE DISTRICT LOCATION MAP

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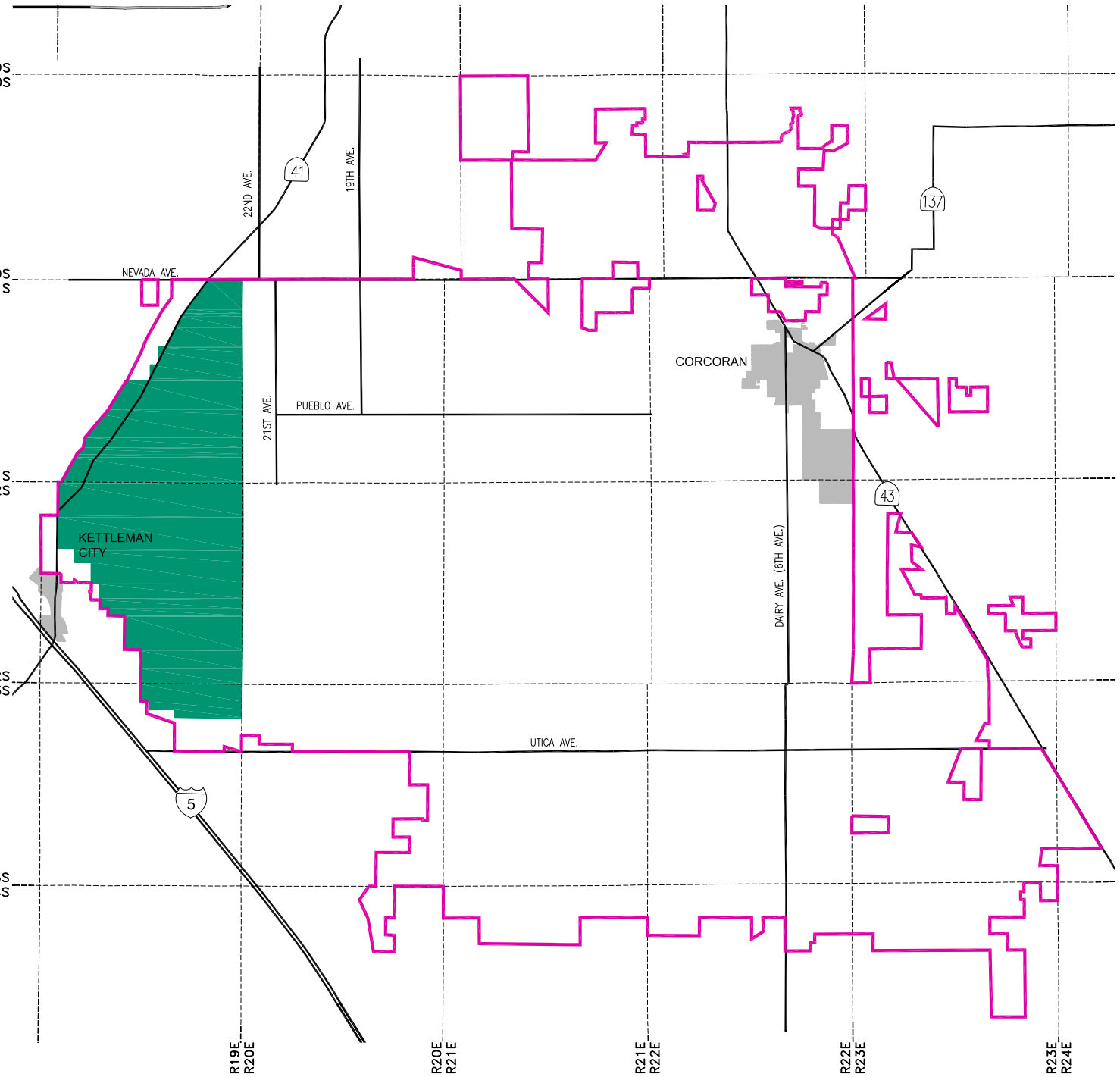
FIGURE 12



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- TULARE LAKE RECLAMATION DISTRICT #761

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

TULARE LAKE RECLAMATION DISTRICT #761 LOCATION MAP

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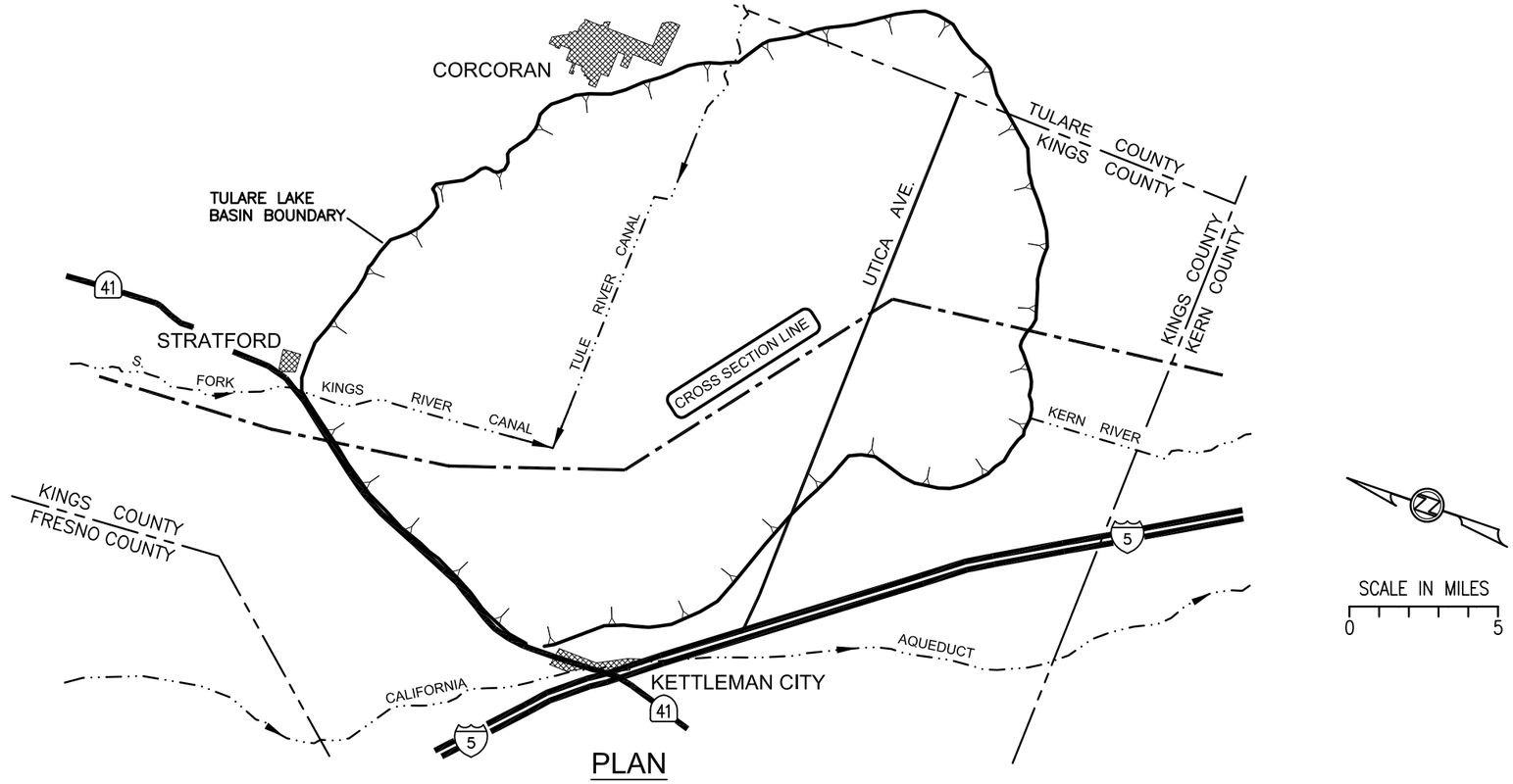
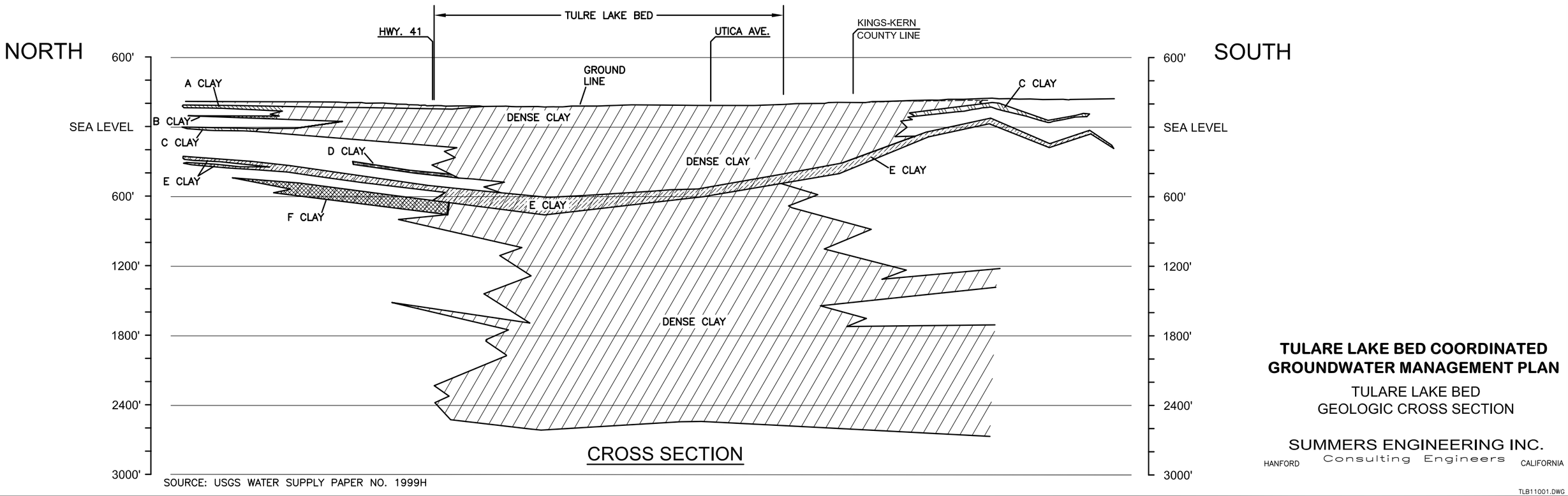
FIGURE 13





SOURCE: USGS WATER SUPPLY PAPER NO. 1999H

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

TULARE LAKE BED
GEOLOGIC CROSS SECTION

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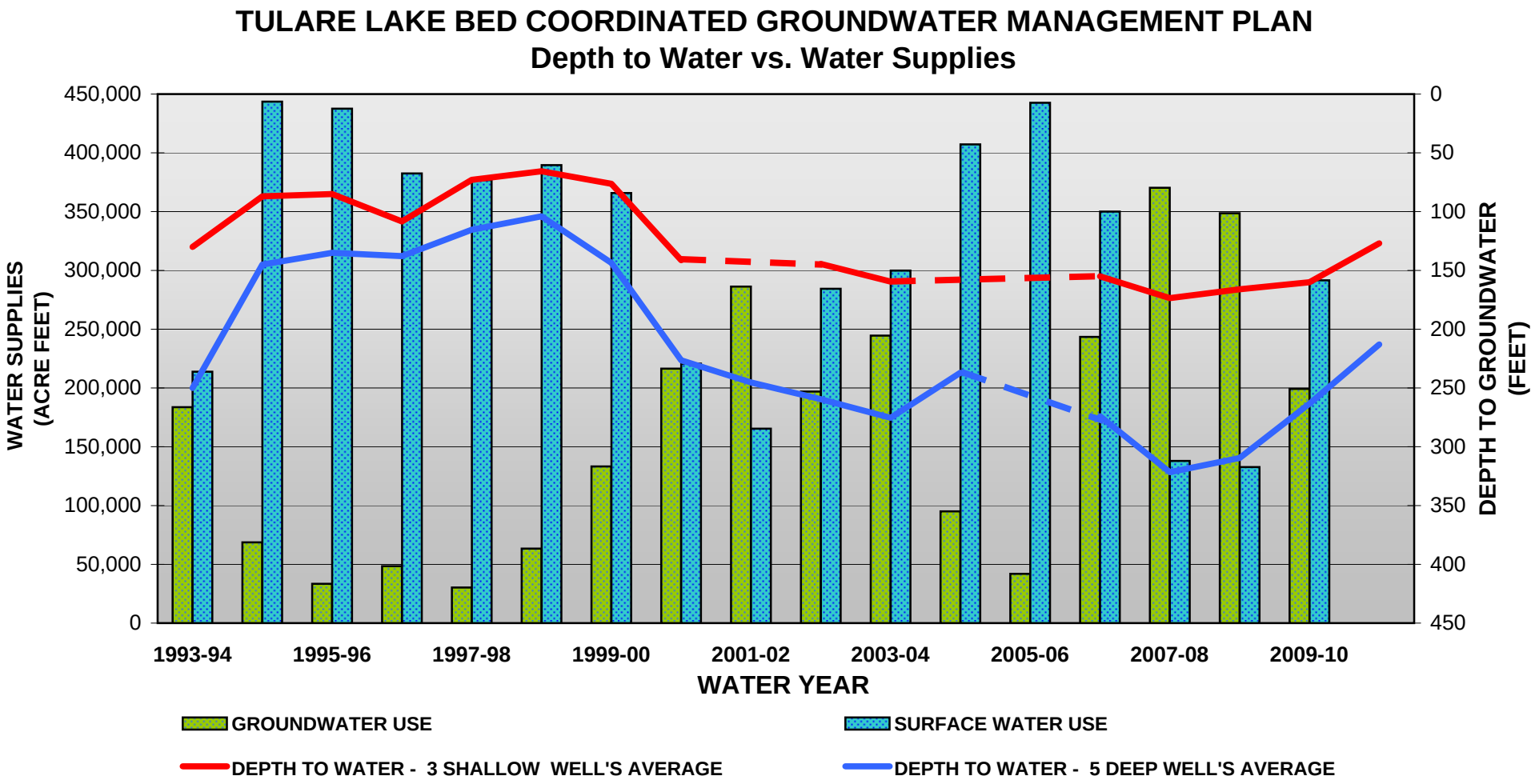
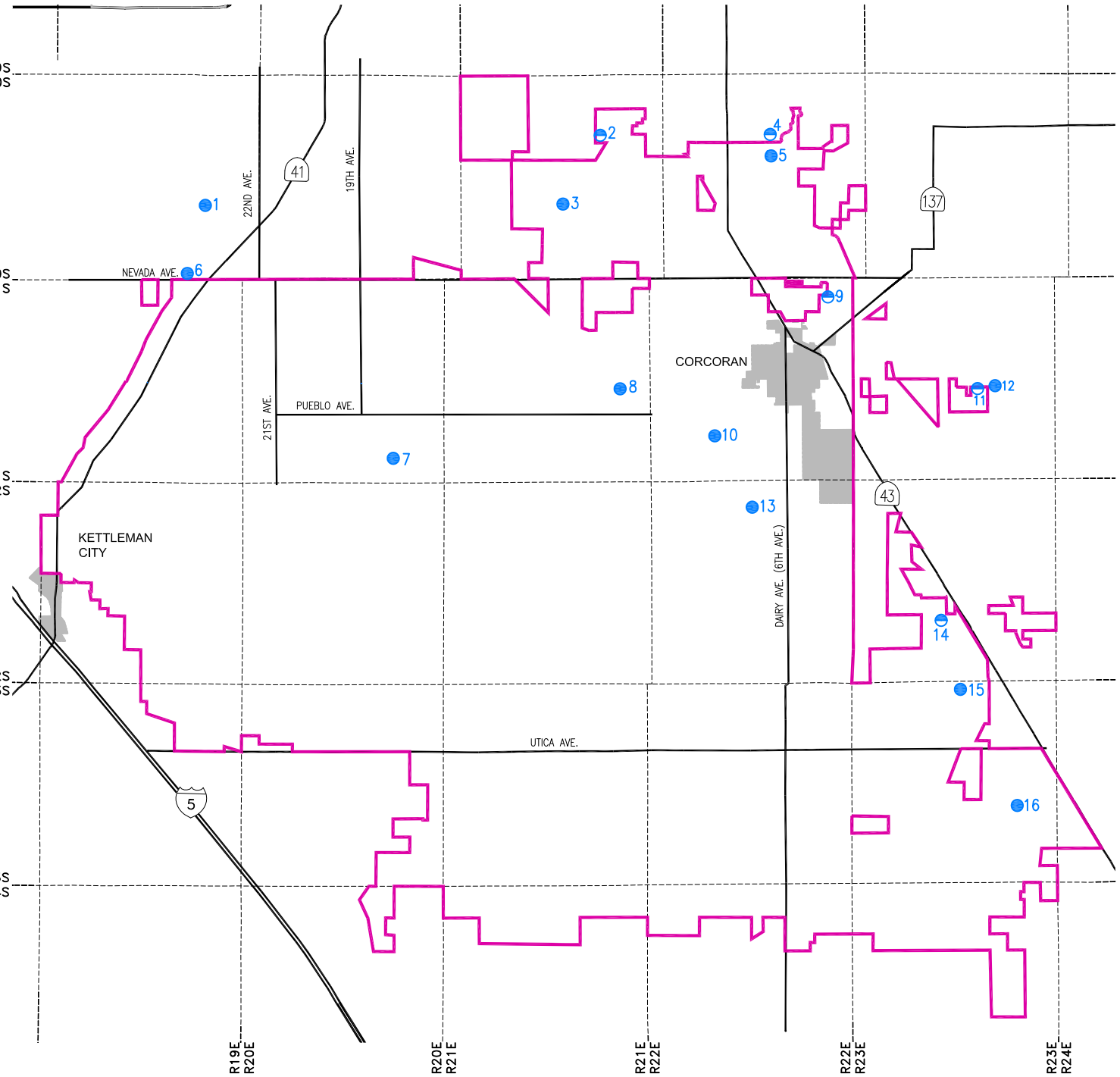
HANFORD Consulting Engineers CALIFORNIA

TLB11001.DWG



NOTES:
1. DASH LINE REPRESENTS MISSING DATA.
2. DEPTH TO GROUNDWATER IS AN AVERAGE OF THREE (3) SHALLOW WELLS AND FIVE (5) DEEP WELLS LOCATED WITHIN THE PLAN AREA.
3. WATER SUPPLIES EXCLUDE DELIVERIES TO LANDS WITHIN THE TULARE LAKE RECLAMATION DISTRICT NO. 761.

FIGURE 15



LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- SHALLOW CASGEM WELL
- DEEP CASGEM WELL

SCALE IN MILES
0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

CASGEM WELLS LOCATION MAP

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